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Measuring temperatures at sea in the 18th century[1]

Introduction

In the 18th century a number of sciences grew out the common stock from which, until that time, they had been barely, if at all, distinguishable. Intercontinental voyages, which had become an almost everyday occurrence for merchant ships in that century, meant that the distant lands visited were being studied in ever greater depth. People became interested in knowing the seas they crossed; they attempted to understand and map wind patterns and ocean currents; nautical charts and sea levels were constantly being corrected as measurements of longitude became more accurate. Coastal contours were redrawn, sandbanks and shallows recorded on charts, and islands located with ever greater precision. Protracted stopovers in foreign lands made it possible to study exotic fauna and flora, as well as foreign peoples. In short, ethnology, botany and zoology developed into fully fledged sciences, together with geography, oceanography, meteorology and even economics.

These developments were due not only to the opening up of man's horizons but to the methods of inquiry being used. Data were systematically collected, described and compared. Scientific theories were articulated and tested. It is hardly surprising that shipping, and especially the long-distance trade, provided a perfect crucible for this work, although the motivation for doing science in this field was, in fact, far from disinterested. It was certainly not science for its own sake. Increasing man's understanding of the seas and other lands was aimed at raising the profitability and efficiency of merchant shipping, sometimes at reaching an even 'nobler' goal: "Through research it was hoped to promote agriculture, trade and prosperity, so that eventually a better – preferably Christian – society would come into being (transl.)."[2]

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[1] We are indebted to Dr. Eric Lee for having translated our paper from Dutch with the outmost accuracy. We are especially grateful to Dr Gaston Demarée of the *Koninklijk Meteorologisch Instituut van België* for his meticulous reading of this manuscript, suggesting a number of corrections, and providing additional information.

[2] J. VAN GOOR, *Handel en wetenschap*. In: *VOC en Cultuur. Wetenschappelijke en culturele relaties tussen Europa en Azië ten tijde van de Verenigde Oostindische Compagnie.* J. Bethlehem & A.C. Meijer (eds) Coll. *Thesaurus*, VII, Amsterdam, 1993, p.5.

The leading trading companies had a major though variable part to play in this. In 1713 Witsen, one of the Heeren XVII of the Dutch East India Company, could still write: “Our merchants are most uninquisitive, and quite unversed in scholarship”.

Indeed, contributions to the investigation of natural phenomena were not always or everywhere obvious. In the Dutch East India Company, for instance, scientific activity was sometimes encouraged, only to see the brakes applied when it came to publishing the results, or sometimes quite simply forbidden.[3]

It was not the business of trading companies, of course, to busy themselves with real voyages of discovery or genuine scientific expeditions. The impetus for such projects came rather from government, simply because the logistic and financial burden could no longer be borne by private initiative. With the support and assistance of learned societies and academies, which provided both the scientific instruments and accompanying personnel, scientific expeditions were organised with the full backing of the government from the mid-18th century on. Though there was still no international cooperation in the true sense of the word, informal exchanges of information and instruments did take place.[4]

In the first half of the eighteenth century, scientific research was still mainly limited to collecting data – the first step in any scientific activity. In this connection, we have already pointed in earlier contributions to the valuable information and documentation contained in ships’ papers. We drew a distinction between the various, extremely varied written records to be found on board company ships: logbooks and ships’ journals kept by professional sailors such as commanding officers or mates, journals and diaries written by supercargoes or ships’ priests, as well as the occasional travel records of others who happened to be on board.[5]

Official ships’ documents such as logbooks and ships’ journals contained daily entries regarding the course sailed, wind force and direction, weather conditions, depth, flow and colour of the water, positions of latitude and longitude, distance covered, and compass variations. The logbook was filled in hour by hour by the mate on watch, and it was on the

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[3] K. van BERKEL, *Een onwillige mecenas? De rol van de VOC bij het natuurwetenschappelijk onderzoek in de zeventiende eeuw*. In: *Handel en wetenschap … op. cit.*, p.57.
[4] E. TAILLEMITE, *La Mer au XVIIIe siècle.* In: *La Mer au siècle des Encyclopédies*. J. Balou (ed.) Coll. *Littérature des voyages*, II, Paris-Geneva, 1987, pp.21-22.
[5] C. KONINCKX, *Zuidnederlanders in vreemde dienst buitengaats. Een schakel in de overdracht van nautische kennis in de 18de eeuw*. In: *Nautische en hydrografische kennis in België en Zaïre. Historische Bijdragen.* Coll. *Collectanea Maritima*, III (*Koninklijke Academie van Wetenschappen, Letteren & Schone Kunsten van België*), Brussels, 1987, pp.56-64.

basis of this logbook that the ship's journal was drawn up. The logbook, then, served as a working tool often bearing traces of frequent daily use, whereas the ship's journal was notable for its beautifully drawn columns and regular handwriting. At the end of the century the French Navy administrators standardised ships' journals and provided notebooks with the columns already printed.[6] Quite often ship owners obliged every captain ***and*** mates to keep a journal and to hand this in on reaching their home port. The aim was to make it possible for owners – on the basis of the information to be found in the ship's journals – to adjust their business operations and plan for the future.

It is clear that these documents essentially contained navigational information. Other data, however, concerned meteorological or astronomical events, or even physical phenomena in a broader sense that today would fall under the heading of geography, botany or zoology. In the main, the entries were limited to simply noting and describing observations. Ships' officers could hardly be expected to develop scientific theories on the basis of observations that had no direct bearing on navigation itself.

The entries in ordinary diaries, daybooks and travel records were somewhat different. As a rule they contained far less nautical information; their authors were more interested in anything that was not part of the daily routine, and so in matters less directly associated with shipping. Geography, ethnology, botany and zoology were disciplines studied by ships' priests or chaplains, ships' doctors or surgeons, i.e. by crew members with an academic training who, whether on board or ashore in foreign lands, also enjoyed some free time and a certain freedom of action which allowed them to devote themselves to their 'passions'. It was often the case that this group of seafarers found themselves entrusted with some particular scientific mission by a university or scientific academy.

Finally, it was not uncommon for younger crew members such as midshipmen or cadets in training also to be given scientific assignments to carry out.

In this paper we shall turn our attention to meteorological observations, in particular to temperature readings, mentioned in ships' documents. This was something quite new in the 18th century, and has so far been studied little, if at all, in the historical literature. We did come across an unpublished French doctoral thesis devoted to the study of weather conditions at sea in the 18th century, based on an analysis of ships' journals covering 435 voyages. Yet

[6] E. TAILLEMITE, *op. cit.*, p.29.

the disillusioned author was forced to note: "… we have found no reliable record of barometric levels for a normal voyage. The same goes for temperatures. The thermometer, invented at the end of the 16th century, was not one of a ship's instruments at that time. True, it was during this period that attempts were being made to define a unit of measurement … and that these instruments were still seldom used on land. It never crossed a sailor's mind to concern himself with temperature any more than with the amount of rainfall …"(transl.).[7]

1. A brief history of the thermometer and temperature measurement

Traditional meteorology was originally concerned with the study of such diverse phenomena as wind, precipitation, whirlwinds, the aurora borealis, and even earthquakes. Measuring temperatures also fell under this heading.

In view of understanding early XVIIIth century's temperature measuring, we have to recall some historical facts briefly.

Around 170 BC Galenius had insisted in his treatises on medicine on the need to adopt a neutral standard temperature scale based on a given volume of water at boiling and freezing point. The oldest instruments used for measuring temperature were called thermoscopes. A long-necked glass flask with a partial vacuum inside was immersed upside down in a bath of liquid, which then rose to a certain height inside the flask. More specifically, the liquid in the neck went up or down as the temperature of the air remaining in the flask rose or fell. Adding a graduated scale made it possible to read off fluctuations in temperature; in short, it was thermoscopy that allowed such changes in temperature to be observed.

Thermoscopy fell somewhat into disuse until Galileo Galilei (1564-1642) rediscovered it around 1592 and in 1610 began carrying out new experiments. It is supposed that the liquid Galileo used was wine, while the air in the flask continued to serve as the medium. By the year 1612 Santorio Santorio (1561-1636) had already introduced a decimal calibration, the poles of the scale being determined by the temperature of snow at one end and the heat of a candle flame at the other.[8]

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[7] C. DANEY, *Recherches concernant le temps qu'il a fait au XVIIIe siècle sur l'Atlantique-Nord, entre les 50e et 40e parallèles, d'après les journaux de navigation. Etude sur 30 ans, 1722-1751.* [thèse IIIe cycle – Université de Paris IV] [unpublished] [1978], p.56.
[8] *Histoire générale des sciences.* R. Taton (Editor in chief), vol. II: *La Science moderne (de 1450 à 1800).* Paris, 1969, p.534.

In 1641 Antonio Alamanni, on behalf of Ferdinand II de Medici, grand duke of Tuscany, put together the first calibrated thermometer, in which the liquid now became the medium indicating variations in temperature. In this model, sometimes called the Florentine thermometer, wine spirit or diluted alcohol was used. The scale was divided into 50 graduations, though there was no fixed zero point.[9] The Florentine thermometer was copied virtually throughout Europe, with arbitrary scales varying from 150 to 400 graduations.[10]

In 1644 the Englishman Robert Hooke (1635-1703) added a red dye to the alcohol. He also refined the scale, each degree corresponding to an equivalent rise in the liquid. Hooke thereby showed that a standardised scale was possible, however long the thermometer might be. It was not until 1702, however, that thermometers were calibrated. This was the work of the Danish astronomer Ole Rømer (1644-1710), who set up the scale between two fixed points, namely that of boiling water and of melting snow.[11]

The Jesuit Ferdinand Verbiest (1623-1688) had also taken experimental measurements with a so-called thermoscope,[12] more specifically with a thermobaroscope, an instrument that was also affected by fluctuations in air pressure. Also in the 17th century, the chemist J.-B. Van Helmont (1577-1644) and the mathematician R.-F. de Sluse (1622-1685) had produced thermometers. Van Helmont's thermometer worked on the basis of water and was therefore a thermobaroscope, while de Sluse's contained salt water.[13]

A major breakthrough in the production of thermometers must be attributed to Daniel Gabriel Fahrenheit (1686-1736), who in 1724 introduced mercury as the liquid. The advantage of using mercury is that its thermal expansion is readily detectable and occurs at a uniform rate. Moreover, mercury does not adhere to glass, and at high and low temperatures it remains liquid. Finally, its silver colour makes it easier to read off the temperatures shown. Fahrenheit also improved on previous calibrations. On his scale, 212° F represents the boiling point and 32° F the freezing point of water, the scale between these two marked physical states being divided into 180 degrees. Zero point on the Fahrenheit scale corresponds to the

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[9] *Instruments of Science. An Historical Encyclopedia*. R. Bud & D.J. Warner (eds), New York – London, 1988, p.615.

[10] M. DAUMAS, *Les Instruments scientifiques aux XVIIe et XVIIIe siècles*. Coll. *Bibliothèque de Philosophie contemporaine. Philosophie des Sciences*. Paris, 1953, p.78 ff.

[11] *Instruments of Science … op. cit.*, p.616. R.H. ROMER, *Temperature scales: Celsius, Fahrenheit, Kelvin, Réaumur and Rømer.* In: *The Physics Teacher*, 1982, p.450 ff.

[12] This was, as we have seen, a precursor of the thermometer.

[13] L. DUFOUR, *Esquisse d'une histoire de la météorologie en Belgique*. (Coll. *Institut royal de météorologie de Belgique, Miscellanées*, vol. XL), Brussels, 1950, p.16.

temperature of ammonium chloride solution (NH_4Cl). The graduations on his scale were designed to avoid having negative values. Ultimately, Fahrenheit found that the boiling point of water varied as a function of air pressure; indeed, he was the first to show a correlation between temperature and atmospheric pressure.

Fahrenheit's thermometer was mainly used in Germany, Great Britain and the Austrian Netherlands, while in France preference was given to that of Frenchman de Réaumur. René de Réaumur (1683-1757) perfected a thermometer in 1730 based on the expansion of wine spirit, though he allowed for only one fixed point, namely the freezing point of water.[14]

During the first half of the 18th century people in almost every European country, it seems, turned to making thermometers. And although Fahrenheit's and de Réaumur's served as models, the copies made were nevertheless very different from the originals. In Sweden Anders Celsius (1701-1744) made a mercury thermometer in 1742, with a scale divided into 100 equal parts. The zero point (0°) showed the boiling point of water and 100° the freezing point. After Celsius's death one of his pupils, Mårten Strömer, carried on with his experiments and linked the problems surrounding the thermometer with those concerning the barometer. Daniel Ekström from Stockholm, instrument maker to the *Academy of Sciences*, came to Strömer's aid. In 1750 they improved Celsius's thermometer and inverted the scale, fixing the boiling point of water at 100° and the freezing point at 0°. In contrast to the Fahrenheit thermometer, Celsius's scale worked with minus values. The result was that this new thermometer was named after them; throughout the 18th century this Ekström-Strömer thermometer, which was widely accepted in Sweden, was also called the Swedish thermometer.[15]

In short, the history of the thermometer demonstrates that at the beginning of the 18th century scientists were extremely busy perfecting this instrument. The result of this was that climatology, still in its infancy at that time, was almost entirely limited to recording

[14] *Instruments of Science … ibid.*
[15] N.V.E. NORDENMARK, *Anders Celsius 1701-1744*. (*The Swedish Institute*), Stockholm, 1952, p.72. In the literature the inversion of the Celsius scale is often wrongly attributed to Linnaeus. Not until the 19th century was the Kelvin scale introduced – from the discovery by the Englishman William Thomson (1824-1907), raised to the peerage as Lord Kelvin. Absolute zero was fixed at –273·16° C. It should be made clear that the present Celsius scale first acquired official status in 1948, as Celsius's thermometer, using a centigrade scale it is true, had needed to be adjusted in function of standard atmospheric pressure. At a pressure of 1 atmosphere, water boils at 99·975° C, rather than at the 100° mark on the inverted Celsius scale. From then on this value would constitute a cornerstone of the present Celsius scale. In fact, until 1948 temperature was expressed in degrees centigrade rather than Celsius. Also taken into account was the 'triple point' of water, i.e. 0·01° C, the temperature at which water, ice and steam are in equilibrium.

temperature levels. They were aware of the lack of accuracy, that various types of thermometer were being used, and that calibration varied from one instrument to another of the same sort.[16]

Eighteenth-century scientists corresponded regularly with each other, and in this way observations concerning temperature were exchanged. In this context, under the auspices of the *Académie des Sciences* and the *Observatoire* in Paris a worldwide network came into being: Bouillet in Béziers, Marcorelle in Toulouse, Tully in Dunkirk, Outhier in Bayeux, Wargentin – secretary of the Academy of Sciences – in Stockholm, Celsius in Uppsala, Toaldo in Padua, Gabry in The Hague, Gauthier in Quebec, Alzate y Ramirez in Mexico.[17] Travellers and missionaries reported on their observations, recorded while journeying or living in foreign parts.[18]

As has already been pointed out, all this activity was restricted to collecting temperature data. No correlations had yet been established, and ultimately the observations were not always comparable, though both de Réaumur and van Swinden would endeavour to improve matters.[19] In addition, the conditions in which the measurements were taken were not always well defined. Some simply placed the thermometer in full sunlight, others exposed it completely to wind and weather, while others again placed the measuring instrument in a sheltered spot. Nor was any account taken of atmospheric pressure.

2. Measuring temperatures at sea

Trial temperature measurements were mainly taken on land, though it would not be long before the same was done at sea. Indeed, judging by notes made in ships' documents, it would seem that this was being done by the first half of the 18th century.

On 28th May 1721 the *Sint-Pieter* sailed from Ostend to the coast of Coromandel, Goa and Surat. This was one of the pre-company expeditions of the Austrian East India Company, the so-called Ostend Company. A journal of this voyage, kept by ship's priest Michael De

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[16] N. BROC, *La Géographie des Philosophes. Géographes et voyageurs français au XVIIIe siècle*. (*Association des Publications près les Universités de Strasbourg – Fondation Baulig*), Paris, [1975], p.435.
[17] *Idem*, p.436.
[18] *Ibid*. La Caille took measurements at the Cape of Good Hope, Boudier in Chandernagor, Amiot in Beijing, Guetlard in Warsaw and Delisle in Russia.
[19] R.A. FERCHAULT de REAUMUR, *Règle pour construire des thermomètres dont les degrés sont comparables.* (*Mémoires de l'Académie des Sciences*), 1730, pp.452-507. J.H. van SWINDEN, *Dissertation sur la comparaison des thermomètres*, 1778.

Febure from Gent,[20] has been preserved. It is not a ship's journal in any true sense: longitude and latitude positions were recorded only once the *Sint-Pieter* had passed Madagascar and was well on its way home. Although the ship's course can be reconstructed by and large, it is impossible to chart the voyage with any precision. This is all the more regrettable as De Febure regularly noted down temperature readings – not strictly on a daily basis, it is true, but almost. This example of measuring temperatures at sea remains unparalleled in the early 18th century.[21]

Unfortunately, we are dealing here with an indefinable scale that runs from 0 to 8 degrees by fractions of 1/8 of a degree. The lowest or coldest temperature is ½°, recorded on 4th October 1721 at the southerly latitudes of the roaring forties, between the Cape of Good Hope and the island of St Paul. The highest is 8 degrees, measured on 12th November 1721 aboard the *Sint-Pieter* bound for Goa. This is presumably a scale on which the zero degree mark corresponds to the freezing point of water, for on 31st August 1721 at a latitude suitable for rounding the Cape of Good Hope – which was not sighted until 13th September – De Febure noted a temperature of 1 degree, adding specifically "*fairly cold*". He immediately went on: "*It really was as cool and cold there as is usual in our country between January and February, which is the end of winter for us, for now it is the same here, as their winter is now coming to an end* (transl.)".

Perhaps De Febure's thermometer showed no degrees below zero; for, as has already been mentioned briefly, on 4th October 1721 he indicated a temperature of only half a degree and the following day, on 5th October, wrote in his journal: "*Today the thermometer stood at the 'tempere' mark under the first degree of heat, or the lily* (transl.)".

The hottest temperatures were recorded in India, in the vicinity of Ceylon, in Goa, Calicut and, to a lesser extent, Surat. Here, De Febure noted the greatest fluctuations between day and night temperatures: "*Note that here the thermometer usually stood at 5 degrees of heat, and that the nights here were so cool and so much colder than mid-September at home. By day it was very warm, and in the evening, at night and in the mornings it was noticeably cool so that one could well have done with a fire* (transl.)(31st August)".

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[20] *RUG. FHH. Ms. 929*. The author calls himself "*cappelaen*" [chaplain] and spells his name Michael De Febure. However, N. LAUDE [*La Compagnie d'Ostende et son activité au Bengale (1725-1730) (Institut Royal Colonial Belge. Section des Sciences Morales et Politiques. Mémoires*, vol. XII, fasc.1), Brussels, 1944, p.231] spells it Lefèvre.

[21] We are particularly indebted to Dr Jan Parmentier for bringing the existence of this journal to our attention.

On a number of occasions the author of the journal made the connection between a drop in temperature and the wind force, especially when the *Sint-Pieter* was enjoying a favourable monsoon or trade wind. Just past Madagascar on the homeward voyage the temperature was still only half that recorded in India: "*So that here it is an unsettled harsh season, as it is in our country around the feast of St Baefs* [= 1st October] (3rd May 1722)(transl.)". The link with the offshore monsoon is obvious.

The position of the *Sint-Pieter* on 20th July 1722 was 14°95 <sic> latitude north and 344°47 longitude. De Febure noted: "*Once again the thermometer stood at only 6 degrees of heat or so. This recorded difference often occurs because one day it blows colder than another, for the less wind there is, the more we feel the heat of the sun*" (transl.).

To us this is merely stating the obvious, but it was not so in the eighteenth century, as measuring temperature was still at the experimental stage and making correlations with other phenomena was something new.

The voyage of the *Sint-Pieter* from 5th May 1722 on can be charted somewhat more precisely, as latitude and longitude positions appear in the journal. As a result, it should also be possible to correlate temperature levels with the ship's position at sea. As already pointed out, however, we do not know which system the temperature scale used was based on, and so it remains impossible to convert the temperatures. For the time being, then, it is pointless to try and correlate the ship's position with the temperature levels.

The temperature readings recorded aboard the *Sint-Pieter* may or may not be the earliest; in any event they predate by almost half a century what Dufour takes to be the oldest meteorological observations in the Southern or Austrian Netherlands. These were made by clergyman Jean Chevalier between 1763 and 1773.[22] Somewhat later in 1775, 1776 and 1777 another clergyman, Théodore-Augustin Mann (1735-1809), noted temperature levels measured in Nieuport.[23] It is amazing that in the Austrian Netherlands temperature was first measured at sea and only much later on land.[24]

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[22] L. DUFOUR, *op. cit.*, p.18. Between 1763 and 1773 maximum and minimum temperatures were noted by J. Chevalier; they appeared in the first volume of the memoirs published by the *Société Littéraire de Bruxelles*, founded in 1769 under the aegis of the count of Cobenzl and later renamed *Keizerlijke en Koninklijke Academie van Wetenschappen en Schone Kunsten* [the Imperial and Royal Academy of Sciences and Fine Arts] of Brussels by empress Maria-Theresa in 1772.

[23] G.R. DEMAREE, A.F.V. VAN ENGELEN & H.A.M. GEURTS, *Les Observations météorologiques de Théodore-Augustin Mann effectuées à Nieuport en 1775, 1776 et 1777*. In: *Ciel et Terre*, CX, 1994, 2, pp.41-48.

Within the Swedish East India Company a number of people were working diligently in this field. This is hardly surprising when we recall the tradition of scientific activity in those circles, carried out under the auspices of the University of Uppsala and the Royal Academy of Sciences in Stockholm, not least under the influence of the famous Linnaeus.[25] And the fact that his compatriot Anders Celsius was hard at it making thermometers undoubtedly goes a long way to explaining why it was that early temperature measurements at sea were carried out by the Swedes. Celsius was an astronomer and physicist; in 1730 he was professor of astronomy at Uppsala, where he set up an observatory in 1741. He achieved fame especially with his thermometer, which he explained in a treatise in 1742.[26] In the same year, in the proceedings of the Academy of Sciences he published the observations he had made with the aid of a barometer, as well as one maximum and one minimum temperature reading – measured in Uppsala and accurate to a tenth of a degree – for every month of the year 1741.[27] It is obvious that the original Celsius thermometer was used for this work. Notes on wind direction and cloud cover were also added.

Celsius’s renown does not make it any easier to determine the sort of thermometers the Swedes used. A Swedish meteorological record containing land temperature data for 1722 – possibly one of the oldest of its kind and so predating Celsius’s invention – does not allow us to decide what type of thermometer was being used at that time.[28] In such cases the temperature readings are virtually worthless if they cannot be compared with other data noted in a similar area, in comparable weather conditions regarding wind, precipitation, cloud cover, air pressure etc., and in which the type of thermometer used is known.

Temperature measurements recorded in ships’ journals present us with an almost identical problem. They cover very long periods and seas sailed by company ships bound for

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Id., *The Meteorological Observations of T.-A. Mann at Nieuport in 1775, 1776 and 1777 placed in a context of the XVIIIth century European scientific co-operation*. In: *Proceedings of the Second Meeting of the North European Sub-Group on Historical Climatology*, Tallinn (Estonia) September 29 – October 1, 1994, in: *Paläoklimaforschung – Palaeoclimate Research*, VII, 1994, special issue 2, pp.71-85.

[24] G. Demarée also drew our attention to the existence of the daily observations recorded by Godart, a doctor in Verviers, between 1767 and 1794.

[25] S. SELANDER, *Linnélärjungar i främmande länder*. Stockholm, 1960.

[26] A. CELSIUS, *Beobachtungen von zween beständigen Graden auf einem Thermometer*. (*Abhandlungen der schwedischen Akademie*, IV), Stockholm, 1742.

[27] A. CELSIUS, *Utdrag af de meteorologiske observationer, som äro hållne i Upsala åhr 1741*. In: *Kungliga Vetenskapskademiens handlingar*, vol. III, pp.12-16.

[28] H. BERGSTRÖM & H. ALEXANDERSSON, *Risingejournalen, april 1732. En gammal östgötsk väderjournal*. In: *Polarfront. Medlemsblad för svenska meteoroligiska sällskapet*, XX, 1993, n° 77, pp.25-29. Perhaps this was the thermometer made by Kircher (1641).

the Far East (China, India) or on the return voyage to Europe, i.e. in the North Sea, the Atlantic or Indian Ocean, or the China Sea.

The earliest observations we found were in the journal of brothers Herman Johan and Israël Reinius aboard the East India vessel *Crontprintzen Adolph Friedrich*.[29] The two brothers had signed on as cadets or midshipmen. Although the journal has been attributed to both of them, it would appear from closer study of the manuscript that Israël Reinius was the author.

The *Adolph Friedrich* left from Gothenburg for China on 13th February 1746 (O.S.).[30] From sheer necessity, having missed the onshore monsoon wind, the ship was forced to winter on Mauritius from 12th October 1746 to 23rd February 1747. On 13th June 1747 she dropped anchor in Canton, from where she would set out on her homeward voyage on 6th January 1748. On 27th June 1748 the *Adolph Friedrich* tied up in her home port of Gothenburg.

Not until 2nd May 1748 (O.S.) did the first note on temperature appear. That was during the homeward voyage, barely a month after leaving Ascension Island, where the ship had been anchored on 6th and 7th April. On 2nd May the ship crossed the tropic of Cancer. The journal gives 23° 32 as both the estimated and observed latitude north, and as longitude 36° 21 west of the Lizard and 21° 31 west of Ascension Island. Reinius noted: "*It is now getting warmer, so that the thermometer at its coldest had dropped to 17°, but then climbed steadily and now showed 10°*". On the same date Reinius specified: "*Since the northeast trades had been encountered at 4° 48 latitude north, it had been forbidden to run around barelegged or in light clothing, as the nights, just like the northeasterly wind, was considerably colder. In order to remain healthy and maintain our [body] temperature, we were compelled to put on more clothes*" (transl.).

It is clear that Reinius used a thermometer with an inverted scale; as the temperature rose, i.e. the warmer the weather became, so the readings gave falling values. The correctness of this conclusion is further confirmed by his commentary on 1st June: "*In recent days the*

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29 *GÖT.SJÖ.MUS. Ms. 9571. Journal hållen på Resan till Canton i China … uptecknade af Herman Johan Reinius och Israël Reinius*. [copy of the original kept in *Österbottens Historiska Museum* in Vaasa (Finland)]. There is a printed edition, although not all data from the original were included: *Journal hållen på* .... B. Lunelund (ed.) (*Svenska litteratursällskapet i Finland*, vol. CCLXXIII), Helsingfors, 1939.

30 O.S. = old style. Not until 1753 was reform of the Gregorian calendar implemented in Sweden, the 17th February being immediately followed by 1st March. True, both notations were often to be found side by side in ships' journals until 1753.

cold has increased appreciably; for the thermometer that read 25° yesterday has now dropped to 35° in the sun" (transl.).

From 30th May up to and including 25th June, the eve of their arrival back in Gothenburg, the temperature was measured daily (see map 1).

From time to time Reinius makes it clear that he took his temperatures "*i wärmen*" [= in the heat], which amounts to saying 'in the sun'. The thermometer was not, then, read in the shade. Whether he recorded only the highest temperature or the lowest is not clear. On 6th June he states: "*Thermom. 45° i Medio*" [thermometer 45° at the midpoint], which shows that this is an average value, and it may be inferred from this that Reinius perhaps took more than one reading a day, though without recording them all.

It is virtually certain, then, that an inverted scale was being used; indeed, on the face of it, it might be assumed that this was Celsius's original (1742) thermometer. But that is by no means certain, because converted into present-day Celsius values – insofar as the formula (100 – x = y° C) applies – the temperatures for the month of June, taken at sea, remember, appear far too high. The temperature does fall (rising absolute values) as the *Adolph Friedrich* crosses higher latitudes in the North Atlantic, only to rise once more (falling absolute values) as the ship sails into the North Sea and nears the Scandinavian peninsula.

Unfortunately, though we may be positive this is a thermometer with an inverted scale, which type of instrument and calibration we are dealing with here remain a mystery.

Another journal in which temperature measurements were noted is that kept by Johan Friedrich Dalman.[31] This covers the voyage of the Swedish East India vessel *Freden*, which left Gothenburg on 20th February 1748 (O.S.) bound for Canton in China. The *Freden* was back in Gothenburg on 11th July 1749 (O.S.).

Another journal covering the same voyage, kept by ship's priest Gustaf Fr. Hjortberg, has been preserved.[32] In contrast to Dalman's, Hjortberg's journal contains no temperature measurements; moreover, the navigational data in it are incomplete. Dalman's journal, on the other hand, is exhaustive, making it possible to chart the *Freden*'s voyage (see map 2). Dalman kept his record at the request of the Royal Academy of Sciences in Stockholm,

[31] *KVABS. Ms. Dalman J.F. Dagbok uppå Konglivetenskaps Academiens befalning hållen af Joh:Frid: Dalman under resan från Giötheborg til Canton och Hem som börjades År 1749 d. 11 Julÿ.*

[32] *KBS. M.281, a, b & c. Ost-Indisk Resa 1748 och 1749 förrättad och beskrefwen af Gustaf Fr. Hjortberg.*

though it is not obvious what his role aboard the *Freden* was. To judge from his entries, it is quite clear that he was well versed in navigation, astronomy and map-making. The very fact that he was given a scientific assignment testifies to the seriousness with which he collected and recorded his data. He gave daily temperature levels, accurate to within half a degree. The lowest temperature he noted was zero degrees as the ship left Gothenburg; the highest was 30°, measured in Canton. We do not know what thermometer was used in this case either.

By analogy with the measurements taken today, Dalman's temperature values indicate a scale similar to that used on the improved Celsius thermometer. Under the heading 'Remarks' Dalman points out that he had only one thermometer. Accordingly, he handled it with the greatest care. He did not dare expose it to all weathers but kept the instrument in a wooden case or sheath that hung in his cabin window. He relates that he sometimes held the thermometer up in the wind "*whenever it was blowing cold*", but that in such cases the temperature dropped no more than two degrees within a quarter of an hour. Perhaps Dalman's task was to try the instrument out. We recall that Strömer and Ekström's thermometer was not invented until 1750, while Dalman's notes date from 1748-1749. Unfortunately, we are told nothing further, although it is quite clear that Dalman was trying to find a connection between temperature and wind force.

However that may be, his observations enable us to chart his temperature readings for the entire voyage.[33]

While the vessel was in Cadiz and Canton, daily temperature measurements were taken on board and recorded.[34] Dalman noted only one temperature reading a day in his journal, with one exception. Indeed, while in Canton, on 21st December 1748, he recorded 15° in the temperature column; though in the margin he noted that the thermometer read 35° in the sun. A difference of 20° is remarkable, and shows that it must have generally been quite cool in his cabin.

A third journal with data on temperature covers the voyage of the Swedish East India vessel *Götha Leyon*, which left Gothenburg on 1st April 1750 (O.S.) for Surat in India and Canton in China. The outward voyage took them through the Channel with a short stop in Dunkirk (19th – 22nd April 1750), then on to Madeira (4th – 11th May 1750) and Juan de Nova

[33] On the chart we have limited ourselves to noting one temperature reading a week.

(16th – 20th August 1750) in the Mozambique Channel. From Juan de Nova the *Götha Leyon* sailed to Surat, where she remained at anchor for five and a half months (from 16th September 1750 to 1st March 1751). From Surat she sailed via the Strait of Malacca to Canton, but not before she had called in at other ports, including Mangalore, Mahé and Kedah. She remained in Canton from 6th July 1751 to 4th January 1752. The course of the homeward voyage was very similar to that of most Swedish East India vessels. After a halt on Ascension Island (6th – 8th April 1752), the *Götha Leyon* sailed homewards, passing through the Channel and reaching Gothenburg on 26th June 1752. In a word, a long trip, not only in distance but in time as well.

The manuscript containing the temperature measurements bears the title ‘sea journal’ and was written by C. H. Braad, ship’s clerk aboard the *Götha Leyon*.[35] Braad states that he took the daily notes on wind, weather and compass variation from the ship’s logbook. He borrowed the data on course, latitude and longitude from Balthazar Grübb, the second mate.[36] All this means that Braad’s journal contains an enormous amount of information and is very complete as far as navigational data are concerned. Here too we are able to chart the *Götha Leyon*’s voyage (see map 3). Because he copied from Braad the longitudinal data, which are calculated with variable zero meridians, we have also included in the tables the longitude data found in another journal. This is the journal of first mate George Elphinstone, who mainly recorded the longitude of the London meridian. In spite of the details he gives regarding the source of his notes, Braad does not tell us where his temperature readings came from. They first appear in his journal on 10th April 1750. The *Götha Leyon* was then still off Marstrand,[37] the ship having apparently had some difficulty finding a favourable wind to reach the open sea.

During the first leg of the voyage, from Gothenburg to Funchal on Madeira, very few temperatures were recorded; once past Madeira, however, Braad noted the temperature daily.

The temperature levels he observed were given to within a quarter of a degree. On 9th, 10th and 12th July 1750 Braad noted temperature levels twice a day: on 9th July, 15° as against 30° in the sun; on 10th July, 15° as against 18° in the sun; and on 12th July, 17° as against 28° in the sun. At that time the ship’s position was 34° 54, then 35° 41 latitude south, in the

[34] Cf. tables 1 & 2.
[35] *GUB.SOKA. H22 3 [1291]. Sjöjournal öfwer Skeppet Götha Leÿons Resa till Ost-Indien. Åren 1750. 51 och 52.*
[36] Grübb’s original notes have never come to light.

roaring forties on the way to rounding the Cape of Good Hope. The mention 'in the sun' shows that his other temperature readings were very probably not taken in the sun.

With a few exceptions, there are no observations of temperature during the stopover in Surat. Only once the *Götha Leyon* had set sail were these noted again. The same is true of the stopover in Mangalore, Mahé, Kedah, and also in Canton. On the homeward voyage daily temperature measurements appeared in the journal, even during the halt on Ascension Island. We know no more about the type of thermometer used or its calibration than we do in the case of Reinius or Dalman.

A second source relating to this same voyage of the *Götha Leyon* are the letters written by Olof Torén, addressed to Linnaeus.[38] These letters contain an account of the voyage which Torén, who had studied in Uppsala, went on as ship's chaplain. His letters were written between 20th November 1752 and 3rd May 1753. During the voyage his health suffered, and though he did reach his home in Sweden, he died soon after, on 17th August 1753.

As already said, this source is not a journal but a collection of letters. Accordingly, there are no daily entries and even less nautical information. In his fourth letter to Linnaeus he does, however, refer to temperature measurements. The relevant passage reads: "*It is said that the heat in Gamron and Bassora is more intense than in Surat, in which case it must be extraordinarily fierce. It is not surprising, then, that the Dutchmen [of the Dutch East India Company] regard Gamron as a godforsaken post. Even in the month of October the Swedish thermometer still rose to 37°. And what affected our health even more was that periods of intense cold and heat followed each other relentlessly. A Florentine thermometer showed 37° at four thirty in the morning, and by two o'clock in the afternoon it had gone up to 75°. P. Bonaventura has pointed out that it is colder than usual three days before and after the new moon. Besides, winter seldom lasts from May to September, because it rains during that period, whereas the other months are considered to be summer, even though the place lies well to the north of the equator.*"(transl.)[39]

This is the only occasion on which we have come across a comparison between two different thermometer scales. Even so, the data are not precise enough to conclude that the temperature of 37° measured with the Swedish thermometer relates to the 37° measured with

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[37] Fortress and port at the point where the Kattegat and Skagerrak meet, some 30 km northwest of Gothenburg.
[38] O. TOREN, *En ostindisk resa*. Coll. *Tidens Svenska Klassiker*. Stockholm, [1961]. *En Ostindisk Resa til Suratte, China &c, från 1750 April 1. till 1752 Jun. 26*. Coll. *Suecica Rediviva*, vol. V, Stockholm, 1969.

the Florentine thermometer or even to the same time and weather conditions. We are undoubtedly dealing here with the Tuscan thermometer of grand duke Ferdinand II, whereas the Swedish thermometer in question must have been the Ekström-Strömer instrument, i.e. the improved version of Celsius's thermometer.

Unfortunately, with the exception of three observations made during the stopover in Surat, Braad noted no temperatures at ports of call in India; therefore, his information cannot be compared with Torén's either.

It is clear that temperature measurements were not yet systematic enough. On top of this, there was not always a thermometer available. Pehr Osbeck, ship's chaplain aboard the *Prins Carl* – another Swedish East India vessel – which sailed to China in 1750-1752, was kept busy on the voyage making a whole range of scientific observations, though he did complain about not having a thermometer available.[40]

A final note on temperature at sea in the context of the Swedish East India Company was found in a collection of correspondence written by Captain Carl Gustav Ekeberg (1716-1784). Ekeberg enjoyed a long career with the Swedish company. He undertook three voyages as 4th, 3rd and 2nd mate respectively, two as first mate, and a further six as captain.[41] In 1748 he was already in touch with the Academy of Sciences, of which he was made a member in 1761. Somewhat later he even became president, a post from which he resigned in 1768.[42] The collection of letters we allude to concern his voyage to China in 1769-1771 aboard the *Finland*, and were addressed to the Secretary of the Royal Academy of Sciences.[43]

In fact, there are just two temperature readings. The first note mentions that the warm weather was persisting and that the thermometer almost always showed 28°.[44] At that point the *Finland* was on her outward voyage, in the vicinity of the island of Trinidad, which was sighted, in fact, on 26th April 1770. We have, however, no precise indication of longitude or latitude, nor the date on which the temperature reading was taken.

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[39] O. TOREN, *op. cit.*, p.341.
[40] P. OSBECK, *Dagbok öfwer en Ostindisk Resa Åren 1750. 1751. 1752. Med Anmärkningar uti Naturkunnigheten, fråmmande Folkslags, Språk, Seder, hushållning, m.m.* Stockholm, 1757, p.280 [reprint: Coll. *Suecica Rediviva*, vol. V, Stockholm, 1969].
[41] C. KONINCKX, *The First and Second Charters of the Swedish East India Company (1731-1766). A Contribution to the Maritime, Economic and Social History of North-Western Europe in its Relationships with the Far East.* Courtray, 1980, pp.308-310.
[42] *Ibid*., p.412.

The second note is dated 14th May 1770. The *Finland* was at the latitude of the Cape of Good Hope and 14° 43 east of the Tenerife meridian. Ekeberg noted: "*17° in a southerly wind, and 21° in a northerly wind*".[45] Here too there is only very scanty information, and no details about the type of thermometer used. The observations date from the second half of the 18th century, which may tempt us to assume that this was the Swedish thermometer, though the facts are by no means certain.

Conclusion

The examples we have given point to the fact that increasingly greater interest was being shown in temperature as a meteorological phenomenon. As already said, however, the work was limited to noting temperature levels, which was done rather unmethodically. Despite the fact that various thermometers were undoubtedly used, the type of instrument and its calibration were seldom mentioned. Equally, few attempts were made to correlate temperature with other meteorological phenomena such as weather conditions and atmospheric pressure; indeed, in none of the ships' journals we have examined is there any reference to barometers. Most observations were made at sea when the ship was under sail; virtually no connection was made, however, with the ship's speed or the wind force, even though such information was regularly recorded in ships' journals.

In spite of the fact that temperature measurements were in some cases carried out at the request of scientific institutions, the methods used were still a process of trial and error. The scientific bodies themselves do not appear to have been very familiar with meteorological phenomena, and the ad hoc measuring instruments were most likely far from perfect. In fact, the history of the thermometer shows that it was in the first half of the 18th century that an enormous amount of effort went into refining the scale. It is therefore logical that the observers in the field, in this case sailors at sea, had no more success than scientists ashore. However that may be, the value of measuring temperatures at sea in the 18th century lay in simply collecting data. Furthermore, the importance of observing temperatures in distant lands visited only by sailors is obvious: in this way, seamen provided information for scholars at home about temperatures at sea in both the northern and southern hemispheres.

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[43] *Capitaine Carl Gustav Ekebergs Ostindiska Resa Åren 1770 och 1771*. Stockholm, 1773 [reprint: Coll. *Suecica Rediviva*, vol. XIV, Stockholm, 1970].
[44] *Id.*, p.32.
[45] *Ibid.*, p.33.

The theories formulated by scholars on the basis of such temperature data were, naturally, no better than fiction. The count de Buffon (1707-1788), '*intendant du jardin du Roi*' [steward of the King's garden], particularly renowned as a naturalist thanks to his treatises *Histoire naturelle* and *Epoques de la nature*, concluded that the 'temperature of the climate' determined the skin colour, build and beauty of human beings.[46] As late as the end of the 18th century, the jurist and physician Volney (1757-1820), who undertook a voyage to the Near East, posed – not without a certain humour – the question as to the link between temperature and a people's dynamic character, and the right point on the temperature scale at which the tendency towards freedom or slavery is expressed.[47] On this matter, the Italian Pilati di Tassulo had already commented in 1778 that concepts such as climate and temperature are relative. He found that Sicily and Campania lived in wealth and luxury in ancient times, a period when France and England lacked any culture or refinement. This brought di Tassulo to the conclusion that if philosophers at that time had used the same arguments as modern ones – let's just say as our present-day scholars – they would maintain that peoples living in a cold climate become lazy and barbaric and so are doomed to live as savages.[48]

In short, such fragmentary knowledge of climate, temperature and its effects led to philosophical discussions, founded on anything but careful scientific arguments.

In the 18th century the art of weather forecasting gradually emerged. Though just as shaky as the philosophical theories themselves to begin with, this would nevertheless pave the way to finding correlations between temperature and other meteorological phenomena. This point had not yet been reached, however, when the 18th-century East Indiamen sailed to the Far East.

The seafarers could have made other connections, e.g. with regard to hygiene on board, health, preserving food, and so on. Virtually no mention is made of such matters in any of the ships' journals we have examined.

Are the temperature measurements we have mentioned completely worthless, then? Even though the type of thermometer and calibration are seldom detailed, the recorded temperature levels may still be of value for historical meteorology. In a broader, comparative

[46] Georges Louis Leclerc, count de Buffon.
[47] Constantin François de Chasseboeuf, count of Volney, *Voyage en Syrie et en Egypte*, (1787).
[48] C.A. PILATI di TASSULO, *Voyages en différents pays de l'Europe*, I, 1778, p.78.

context, not only can temperature variations be determined, but historical isotherms can also be drawn, which in turn may tell us something about changing weather patterns and offering indications of climate in general.

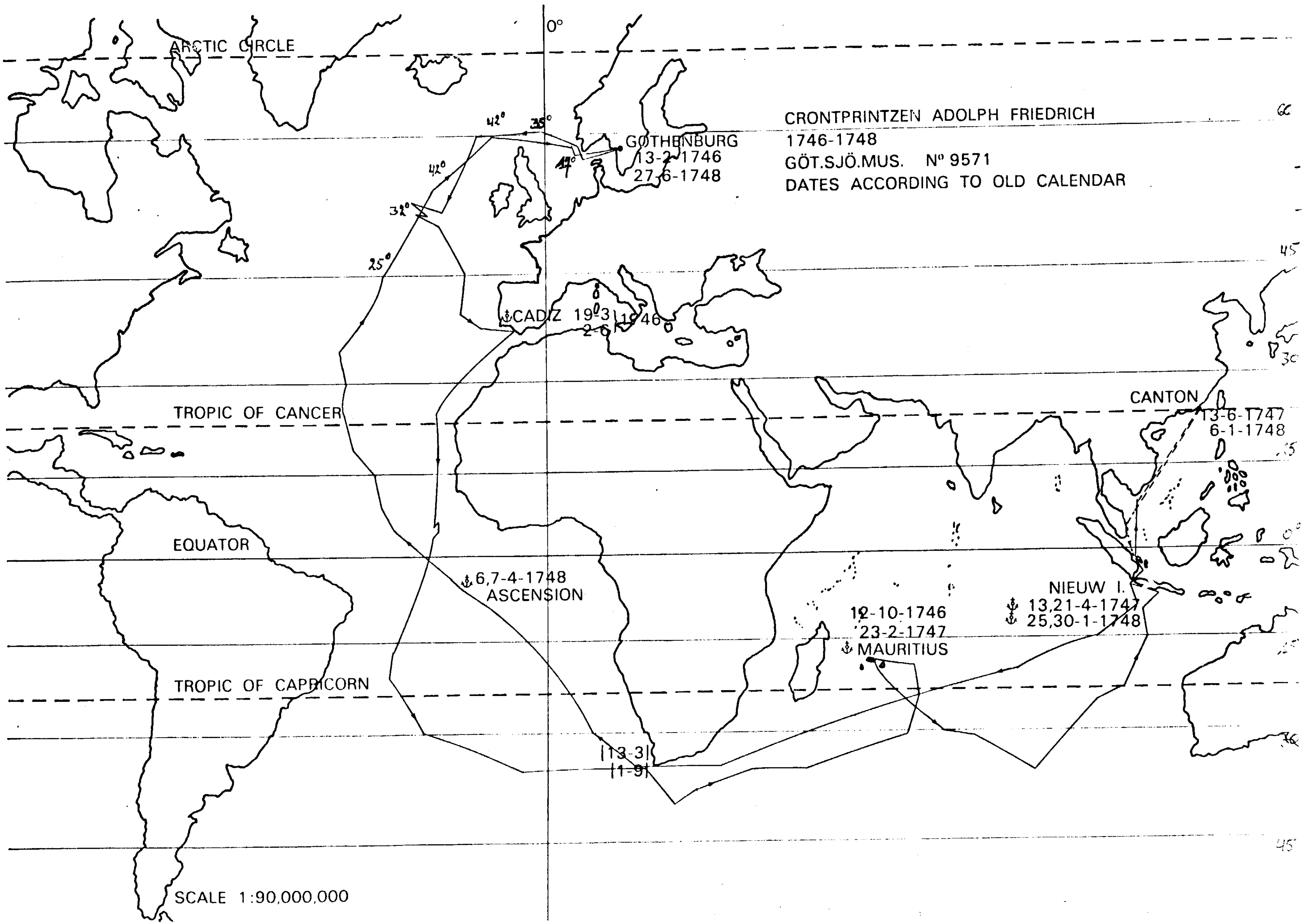
ABBREVIATIONS USED

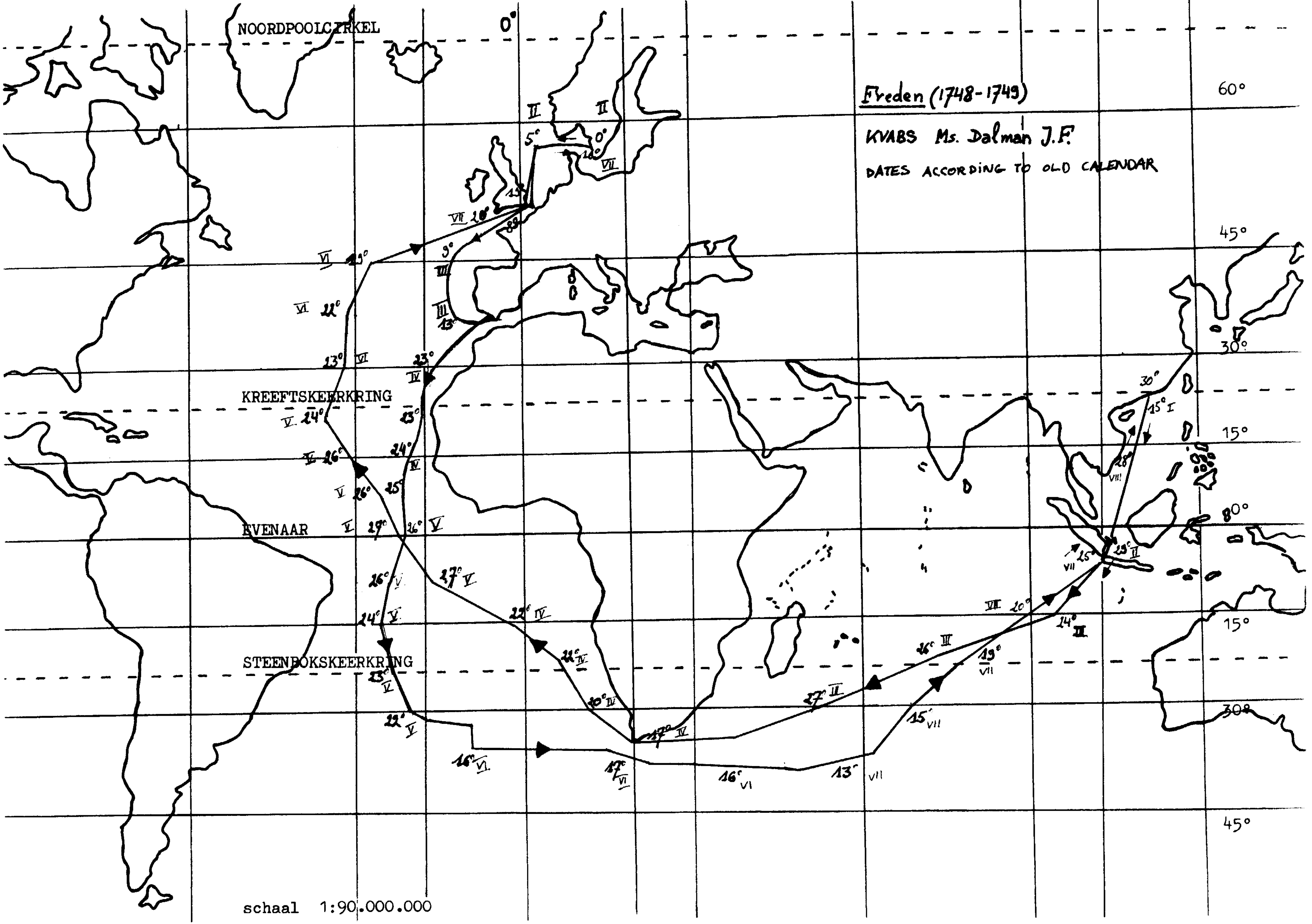
GÖT. SJÖ. MUS.	*Maritime Museum Gothenburg*
GUB. SOKA.	*Gothenburg University Library. East India Company Archives*
KBB. KKH.	*Royal Library Brussels. Rare Manuscripts Department*
KBS.	*Royal Library Stockholm*
KVABS	*Royal Society of Sciences Stockholm*
RUG. FHH.	*Ghent University Library. Manuscripts Department. Hye Hoys Archives*

Cronprintzen Adolph Friedrich *1745-1748* *[GÖT SJÖ MUS 9571]*

date	temperature	Latitude[1]	Longitude	remarks
30-5-1748	15°	43°25	from the Lizard 30°46 W	
31-5	25	[45°7]	29°6	
1-6	35	45°53	27°12	
2-6	35	[47°17]	26°00	
3-6	32	49°49	24°27	
4-6	42	51°40	23°2	
5-6	57	52°39	21°48	
6-6	45	54°46	19°26	
7-6	42	56°47	17°10	
8-6	50	58°18	13°38	
9-6	42	[59°57]	10°2	
10-6	-	[60°46]	6°18	
11-6	42	61°6	4°33	
12-6	42	[60°56]	3°46	
13-6	42	[60°22]	3°9	
14-6	42	60°30	0°9	
15-6	40	[60°50]	-	
16-6	35	[60°44]	3°7 E	observing Hitland
17-6	29	59°55	from Hitland 1°24 E	
18-6	29	58°45	3°10	
19-6	25	57°44	7°42	observing Norwegian coast
20-6	25	57°42	9°22	observing Jutland
21-6	20	-	-	
22-6	20	-	-	Observing Skagen's lighthouse
23-6	20	-	-	
24-6	15	-	-	observing Marstrand
25-6	17	-	-	
26-6	-	-	-	anchoring at Gothenburg

[1] Observed latitude.


CRONTPRINTZEN ADOLPH FRIEDRICH
1746-1748
GÖT.SJÖ.MUS. Nº 9571
DATES ACCORDING TO OLD CALENDAR
ARCTIC CIRCLE
0°
GOTHENBURG
13-2-1746
27-6-1748
42°
35°
42°
32°
25°
CADIZ 19-3 | 1746
2-6 |
TROPIC OF CANCER
EQUATOR
TROPIC OF CAPRICORN
6,7-4-1748
ASCENSION
13-3
1-9
12-10-1746
23-2-1747
MAURITIUS
NIEUW I.
13,21-4-1747
25,30-1-1748
CANTON
13-6-1747
6-1-1748
SCALE 1:90,000,000



Freden (1748-1749)
KVABS Ms. Dalman J.F.
DATES ACCORDING TO OLD CALENDAR
NOORDPOOLCIRKEL
KREEFTSKEERKRING
EVENAAR
STEENBOKSKEERKRING
0°
60°
45°
30°
15°
80°
15°
30°
45°
schaal 1:90.000.000

Freden (1748-1749) [KVABS Ms. Dalman J.F.]

Voyage out

Date O.S.	Temperature	Latitude	Longitude Pico de Tenerife	Remarks
19-2-1748	0°	-		In sight of Vinga
20-2	0°	56°49	22°28	
21-2	0°	55°40	19°8	
22-2	2	54°21	18°0	
23-2	5	52°29	17°34	
24-2	5	51°16	17°23	
25-2	5		-	In sight of Calais
26-2	8	50°46	16°41	
27-2	8	50°0	13°50	
28-2	8½	50°30	13°50	
29-2	8½	50°2	11°50	
1-3	8	49°36	11°15	
2-3	8	50°8	11°45	
3-3	8	49°58	11°8	
4-3	8	50°10	11°8	
5-3	8	49°25	10°10	
6-3	8	47°50	9°3	
7-3	8	47°8	8°16	
8-3	9	44°48	6°6	
9-3	10	43°32	5°38	
10-3	10	40°55	5°14	
11-3	11	37°45	7°0	
12-3	12	-	-	In sight of Cadix
13-3				Anchored at Cadix
9-4	20	35°47	7°41	
10-4	21	35°33	7°23	
11-4	21	35°37	7°8	
12-4	21	33°57	5°34	
13-4	22	32°20	4°4	
14-4	23	29°56	2°7	
15-4	23	28°10	0°23	
16-4	22	25°8	20’	
17-4	23	22°24	1°28	
18-4	23	19°52	2°20	
19-4	24	17°24	3°20	
20-4	24	14°45	3°41	
21-4	24	12°10	3°33	
22-4	25	10°7	3°5	
23-4	25	8°29	2°48	

24-4	25	7°38	2°39	
25-4	25	6°30	2°29	
26-4	26	5°31	2°17	
27-4	26	4°57	2°31	
28-4	26	4°30	2°48	
29-4	26	4°18	2°58	
30-4	27	4°10	2°19	
1-5	26	3°39	1°28	
2-5	26	2°30	2°34	
3-5	26	0°59 N	4°0	
4-5	26	0°30 S	4°54	
5-5	26	2°26	5°40	
6-5	26	3°57	6°12	
7-5	26	5°58	6°59	
8-5	26	7°53	7°29	
9-5	26	10°1	7°56	
10-5	26	11°55	8°29	
11-5	25	14°0	8°51	
12-5	24	15°50	9°29	
13-5	24	16°18	9°47	
14-5	24	17°3	10°43	
15-5	23	18°47	11°29	
16-5	23	20°52	10°39	
17-5	23	22°12	9°53	
18-5	23	22°1	8°43	
19-5	23	22°1	7°38	
20-5	23	22°3	7°4	
21-5	23	23°14	8°1	
22-5	23	24°50	8°1	
23-5	23	26°50	7°9	
24-5	23	28°51	5°27	
25-5	22	30°24	2°56	
26-5	20	31°10	0°17 E	
27-5	20	30°56	2°38	
28-5	20	31°16	3°19	
29-5	19	31°52	4°7	
30-5	19	32°37	5°18	
31-5	19	32°54	7°11	
1-6	17	33°00	7°56	
2-6	17	33°33	8°58	
3-6	16	35°16	10°28	
4-6	17	35°2	12°44	
5-6	18	34°35	13°24	
6-6	17	35°34	16°50	
7-6	17	35°47	20°9	

8-6	15	35°42	23°53	
9-6	14	35°44	27°17	
10-6	13	35°26	30°23	
11-6	14	35°32	32°53	
12-6	15	35°28	34°33	
13-6	16	35°18	36°35	
14-6	17	35°34	37°32	In sight of Cape Agulhas
15-6	16	36°46	39°8	
16-6	17	37°34	42°40	
17-6	17	37°34	46°12	
18-6	18	37°39	49°11	
19-6	17	37°39	52°43	
20-6	17	37°20	55°17	
21-6	17	37°35	56°53	
22-6	17	38°2	58°31	
23-6	18	38°3	60°53	
24-6	18	37°57	64°1	
25-6	16	37°45	67°32	
26-6	16	38°3	69°40	
27-6	16	38°3	73°39	
28-6	17	38°9	75°38	
29-6	17	38°2	79°00	
30-6	17	37°55	82°59	
1-7	17	37°44	87°3	
2-7	16	37°31	91°3	
3-7	13	36°31	94°26	
4-7	14	35°8	98°30	
5-7	15	34°8	102°3	
6-7	16	33°8	105°35	
7-7	17	31°39	108°39	
8-7	14	30°39	109°32	
9-7	15	30°37	110°34	
10-7	16	29°13	112°23	
11-7	18	28°17	113°49	
12-7	18	26°53	115°23	
13-7	18	25°50	115°59	
14-7	19	24°11	116°56	
15-7	19	21°11	118°36	
16-7	19	19°25	119°30	
17-7	20	16°42	121°5	
18-7	21	13°35	122°5	
19-7	24	11°42	122°49	
20-7	25	9°23	123°1	
21-7	25	7°50	123°26	In sight of Java

22-7	25	7°28	[32°43 from S.Paul]	
23-7	25	5°56	-	Passing Head of Java
24-7	26	-	120°48	
25-7	27	6°11	121°00	
26-7	27	5°13	121°16	
27-7	28	4°20	121°34	
28-7	28	2°53	121°17	
29-7	28	2°4	120°41	
30-7	28	1°34 S	120°14	
31-7	28	0°22 N	120°59	
1-8	28	2°35	[120°25]	
2-8	28	4°48	[120°36]	
3-8	26	6°50	[121°40]	
4-8	28	9°5	[123°30]	
5-8	26	10°40	[126°00]	
6-8	27	12°37	[127°29]	
7-8	27	14°15	[128°31]	
8-8	28	16°8	[129°11]	
9-8	28	18°6	[129°53]	
10-8	29	19°54	[130°16]	
11-8	28	20°25	[130°22]	
12-8	27	20°44	[130°20]	
13-8	27	22°15	-	
14-8	28	22°6	128°50	
15-8	28			
16-8	29			
17-8	29			
18-8	30			
19-8	30			
20-8	30			Anchored at Whampoo

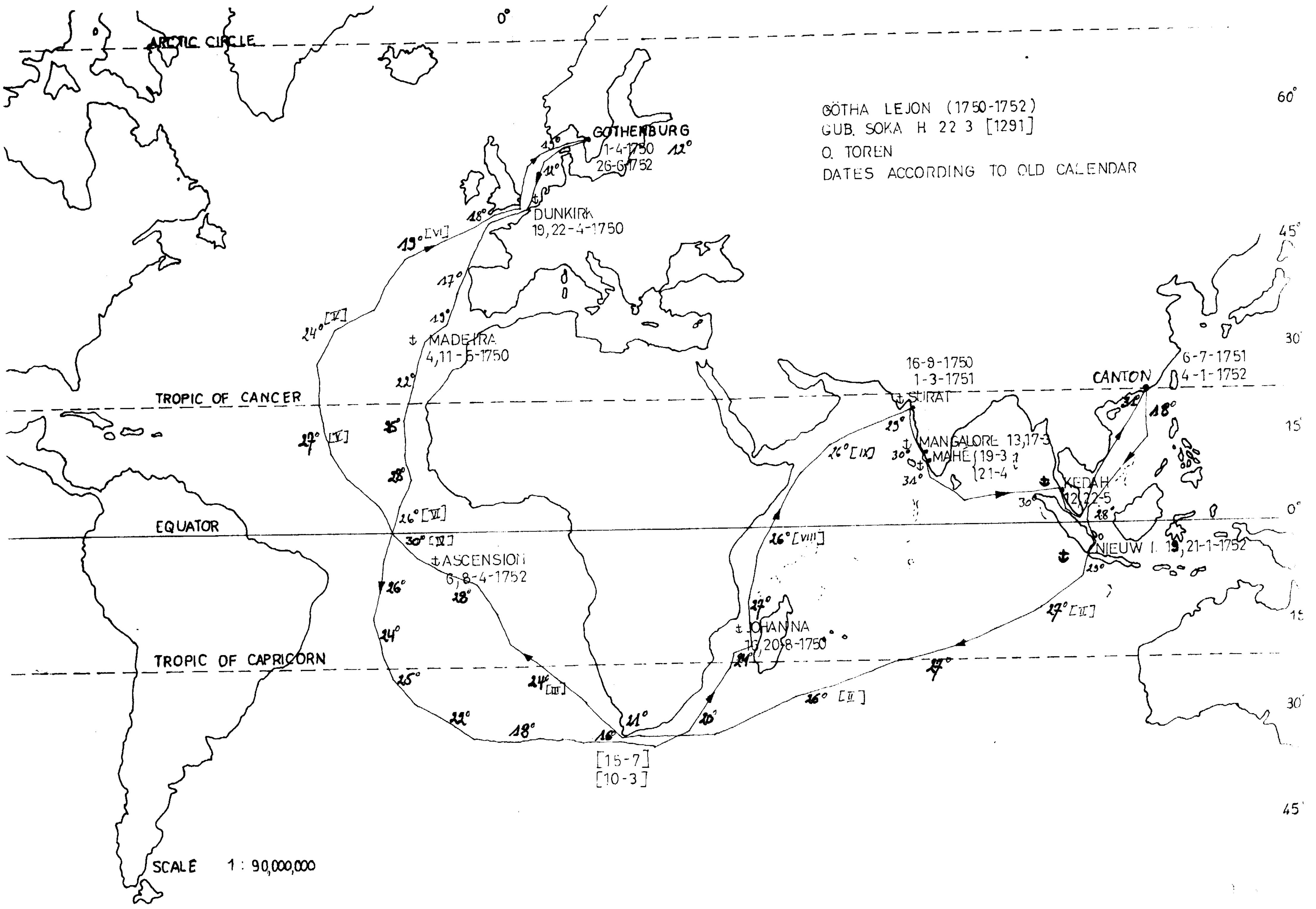
Return

29-1-1749	15	-	-	raising anchor
30-1	13	20°40	[129°1]	
31-1	15	18°21	[129°7]	
1-2	20	15°40	[129°25]	
2-2	24	13°40	[128°12]	
3-2	24	11°36	[127°00]	
4-2	24	9°30	[125°35]	
5-2	24	8°24	[123°00]	
6-2	25	6°32	[121°38]	
7-2	25	5°5	[120°51]	
8-2	25	3°24	[120°2]	
9-2	25	1°47 N	[120°46]	
10-2	26	0°1 S	[121°28]	
11-2	26	1°23	[120°20]	
12-2	26	2°9	[120°45]	
13-2	27	3°17	[121°19]	
14-2	27	3°57	[121°32]	anchoring at Lucepara
15-2	28	5°25	[121°12]	
16-2	29	7°20	[120°15]	
17-2	29	7°20	-	
18-2	29	-	-	
19-2	28	8°26	119°00	
20-2	28	10°18	118°15	
21-2	28	12°12	117°17	
22-2	28	13°15	115°55	
23-2	24	14°00	112°49	
24-2	27	14°36	110°43	
25-2	24	15°17	108°19	
26-2	27	16°12	105°28	
27-2	26	17°5	102°54	
28-2	26	18°56	100°24	
1-3	26	18°30	98°33	
2-3	26	19°14	96°38	
3-3	26	19°35	95°19	
4-3	24	20°9	93°28	
5-3	26	21°00	91°00	
6-3	26	21°32	88°58	
7-3	26	22°4	87°7	
8-3	26	22°34	84°50	
9-3	25	23°8	81°38	
10-3	25	23°53	78°42	
11-3	25	24°32	76°22	

12-3	25	25°34	73°23	
13-3	25	26°38	70°34	
14-3	25	27°27	69°3	
15-3	25	28°1	68°16	
16-3	25	28°32	67°4	
17-3	25	28°50	65°23	
18-3	26	29°33	62°7	
19-3	27	30°28	59°55	
20-3	27	30°45	59°30	
21-3	26	30°50	58°3	
22-3	25	31°29	55°25	
23-3	25	32°16	52°53	
24-3	24	32°36	51°28	
25-3	23	33°6	49°32	
26-3	21	33°19	47°57	
27-3	21	33°30	47°18	
28-3	23	33°41	46°33	
29-3	24	33°21	46°15	
30-3	21	33°41	45°5	
31-3	21	35°26	42°48	
1-4	17	35°56	42°17	
2-4	18	35°40	42°20	
3-4	19	35°37	41°32	
4-4	20	35°21	40°28	
5-4	21	35°35	39°20	
6-4	22	35°51	37°59	
7-4	18	35°50	37°3	
8-4	17	35°20	37°1	
9-4	17	35°24	36°52	
10-4	17	35°17	34°46	
11-4	21	35°9	32°41	
12-4	20	33°36	30°40	
13-4	19	33°18	28°36	
14-4	20	31°00	26°10	
15-4	20	29°00	23°40	
16-4	20	26°50	21°20	
17-4	21	24°50	19°53	
18-4	21	23°14	18°52	
19-4	22	22°6	18°2	
20-4	22	21°14	17°4	
21-4	23	19°50	16°3	
22-4	23	18°30	15°18	
23-4	24	17°41	14°37	
24-4	23	16°45	13°15	
25-4	22	16°2	10°45	

26-4	22	16°00	9°11	
27-4	22	16°00	-	anchoring at S. Helena
28-4	22	-	-	
29-4	22	-	-	
30-4	22	-	-	
1-5	22	15°6	8°17	
2-5	23	13°57	7°12	
3-5	24	12°6	5°25	
4-5	26	10°19	3°46	
5-5	26	8°42	1°58	
6-5	27	6°52	0°14 E	
7-5	27	5°7	1°28	
8-5	27	3°45	2°50	
9-5	27	2°27	4°8	
10-5	27	1°7	5°34	
11-5	27	0°25 N	6°39	
12-5	27	1°48	7°38	
13-5	27	3°9	8°16	
14-5	27	4°14	8°39	
15-5	27	4°57	8°53	
16-5	26	5°12	8°53	
17-5	26	5°40	8°50	
18-5	25	6°27	9°3	
19-5	26	7°5	10°11	
20-5	26	8°9	11°34	
21-5	26	9°19	12°43	
22-5	26	10°48	13°51	
23-5	26	12°12	14°58	
24-5	26	13°37	16°22	
25-5	26	15°15	17°47	
26-5	25	17°10	19°6	
27-5	25	19°8	20°30	
28-5	24	20°50	21°5	
29-5	24	22°25	22°34	
30-5	24	24°11	23°38	
31-5	24	26°9	24°20	
1-6	24	27°19	24°25	
2-6	24	27°58	24°5	
3-6	23	29°17	23°7	
4-6	23	29°40	22°49	
5-6	23	30°10	22°22	
6-6	24	30°4	21°54	
7-6	24	30°53	21°36	
8-6	24	32°18	20°37	

9-6	23	32°25	19°17	
10-6	22	32°53	18°52	
11-6	23	33°16	18°40	
12-6	24	33°17	18°43	
13-6	23	33°55	19°29	
14-6	22	34°39	19°37	
15-6	22	35°47	19°32	
16-6	22	37°20	19°27	
17-6	22	39°27	19°12	
18-6	22	41°43	17°17	
19-6	20	42°47	15°26	
20-6	19	44°18	12°2	
21-6	20	45°46	8°55	
22-6	20	47°30	5°3	
23-6	20	48°20	3°30	
24-6	19	49°8	0°38 W	
25-6	18	49°36	1°37	
26-6	19	49°42	4°17	
27-6	19	49°45	6°31	
28-6	19	49°43	9°11	
29-6	19	50°4	10°15	
30-6	20	50°10	10°45	
1-7	20	50°2	11°50	
2-7	20	50°30	14°20	
3-7	19	50°50	16°49	in sight of Dover
4-7	19	52°58	18°42	
5-7	18	54°27	19°20	
6-7	18	55°48	20°41	
7-7	15	55°30	20°6	
8-7	16	56°4	21°30	
9-7	15	57°28	24°40	
10-7	15	57°54	-	In sight of Vinga
11-7	16	-	-	Anchoring at Gothenburg


GÖTHA LEJON (1750-1752)
GUB. SOKA H 22 3 [1291]
O. TOREN
DATES ACCORDING TO OLD CALENDAR
ARCTIC CIRCLE
TROPIC OF CANCER
EQUATOR
TROPIC OF CAPRICORN
SCALE 1 : 90,000,000
GOTHENBURG
1-4-1750
26-6-1752
DUNKIRK
19, 22-4-1750
MADEIRA
4, 11-5-1750
ASCENSION
6, 8-4-1752
[15-7]
[10-3]
JOHANNA
19, 20-8-1750
16-9-1750
1-3-1751
SURAT
MANGALORE 13,17-3
MAHÉ (19-3
(21-4
KEDAH
12, 22-5
NIEUW I. 19, 21-1-1752
CANTON
6-7-1751
4-1-1752
0°
60°
45°
30°
15°
0°
15
30°
45°

<u>*Götha Leijon*</u> *1750-1752* *[GUB.SOKA. H 22 3 (1291)]*

date	**temperature**	**latitude**	**longitude[1]** **[Braad]**	**longitude[2]** **[Elphinstone]**	**remarks**
1-4-1750	-	-	-		depart from Gothenburg
	-	-	-	-	waiting for permitting wind
10-4	12°	57°44	1°25[3]	9°9	in sight of Marstrand
11-4	10½	56°4	3°2[4]	5°47	in sight of Jutland
12-4	10	53°52	4°22[5]	4°8	
13-4	12	53°1	4°50[6]	3°15	
14✍28-4	-	-	-		short stop at Dunkirk; crossing the Channel: no figures for temperature
29-4	17	38°18	from Fairley 8°59	12°42	
30-4	18	36°40	9°38	13°32	
1-5	19	35°00	10°26	14°29	
2-5	19	33°5	10°24	14°29	
3✍11/5	-	-	-		at anchor at Funchal
12-5	-	30°53	from Madeira 0°31 W	18°4	
13-5	22	28°52	1°32	19°13	in sight of Palma
14-5	23	26°13	2°10	19°16	
15-5	23	24°20	2°36	20°26	
16-5	23	21°51	3°13	21°6	
17-5	23	19°32	3°20	21°14	
18-5	24	17°23	3°30	21°23	
19-5	25	15°14	3°38	21°31	
20-5	26	13°41	3°27	21°22	
21-5	27	11°41	3°9	21°4	

[1] Variable ’meridian distance’.
[2] From London.
[3] Longitude from Marstrand according to *Kort Dagbok öfver en resa med skeppet Götha Leyon hållen af Georg Elphinstone (KVAB).*
[4] Idem.
[5] Idem.
[6] Idem.

22-5	28	9°57	2°38	20°31	
23-5	28	9°19	2°38	20°31	
24-5	28	7°36	2°9	20°4	
25-5	28	6°25	1°59	19°53	
26-5	28	6°5	2°19	20°14	
27-5	29	5°57	2°24	20°14	
28-5	28	5°47	2°24	20°14	
29-5	27	4°50	3°14	21°4	
30-5	26	3°59	3°39	21°28	
31-5	26	2°39	4°43	22°31	
1-6	26	2°19	3°45	21°28	
2-6	26½	1°39	5°00	22°48	
3-6	26¼	0°22 N	5°50	23°32	
4-6	26½	1°7 S	6°19	24°4	
5-6	26½	2°41	6°53	24°29	
6-6	26½	4°25	7°43	25°17	
7-6	26¼	5°57	8°43	26°00	
8-6	26½	7°44	9°4	26°30	
9-6	26¾	9°25	9°27	26°52	
10-6	26	11°13	9°54	27°21	
11-6	26	12°57	10°5	27°38	
12-6	25	14°30	10°25	28°00	
13-6	24½	16°7	10°10	27°43	
14-6	24	17°50	9°42	27°12	
15-6	24	19°8	9°9	26°26	
16-6	24	19°46	8°42	26°5	
17-6	25	20°7	8°36	25°56	
18-6	23	20°46	8°53	26°12	
19-6	23	22°17	8°58	26°12	
20-6	23	24°1	7°34	24°38	
21-6	22½	25°1	6°42	23°39	
22-6	22	26°56	5°12	21°54	
23-6	22	28°56	3°32	20°7	
24-6	22	30°46	1°42	17°53	
25-6	18	30°56	0°1 O	16°11	
26-6	18½	31°43	1°15	14°34	
27-6	16	32°49	3°5	11°24	
28-6	14	34°4	6°41	7°58	
29-6	12	34°56	9°31	4°30	
30-6	12	35°27	12°32	0°50 W	
1-7	12	35°36	15°11	2°5 E	
2-7	13	35°47	16°37	4°10	
3-7	15	35°52	19°45	8°00	
4-7	16	35°45	22°39	11°33	
5-7	13	35°31	24°45	14°15	

6-7	13	35°9	26°13	15°50	
7-7	13	34°49	27°5	16°49	
8-7	13	34°56	27°5	16°49	
9-7	15 30 in the sun	34°54	28°8	18°15	
10-7	15 18 in the sun	35°41	30°1	20°24	
11-7	17	35°56	32°24	23°17	
12-7	17 28 in the sun	35°25	34°27	25°55	
13-7	16	35°57	35°27	27°10	
14-7	16	35°36	37°2	29°9	
15-7	17	36°24	from Cape Agulhas 2°56	21°46	
16-7	19	36°28	5°24	24°13	
17-7	20	36°46	7°32	26°21	
18-7	20	36°26	9°55	28°43	
19-7	17	36°16	12°22	31°9	
20-7	18	35°40	14°46	33°24	
21-7	17	34°34	16°31	35°28	
22-7	17	33°9	17°43	36°42	
23-7	19	32°9	19°12	38°2	
24-7	20	31°27	20°29	39°22	
25-7	18	28°57	21°40	40°32	
26-7	18	27°5	22°32	41°19	
27-7	20	26°10	22°37	41°29	
28-7	22	24°19	24°33	43°25	
29-7	24	23°22	25°27	44°13	Madagascar observed
30-7	25	23°00	-	44°13	
31-7	25	21°55	-	44°00	
1-8	25	19°57	-	43°54	
2-8	27	18°53	-	43°58	
3-8	25	18°18	-	44°10	
4-8	26	17°29	-	44°34	
5-8	26	16°21	-	44°20	I.Paracel seen
6-8	26	14°59	-	44°49	
7-8	26	13°48	-	44°49	
8-8	26	13°11	-	45°4	Mohilla & Mayotta observed
9-8	26	13°1	-	45°29	Johanna observed
10-8	26	12°00	-	45°53	idem
11-8	27	12°9	-	45°53	idem

12-8	27½	11°47	-	45°20	anchoring at Johanna
13-8	24	-	-	-	
14-8	24	-	-	-	
15-8	25	-	-	-	
16-8	24	-	-	-	
17-8	25	-	-	-	
18-8	26	-	-	-	
19-8	26	-	-	-	
20-8	27	12°6	-	-	raising anchor
21-8	27	11°48	-	-	
22-8	26	10°4	from Johanna 0°2 W	44°53	
23-8	26	7°54	0°10	44°47	
24-8	26	5°48	0°23	44°31	
25-8	26	4°10	0°32	44°22	
26-8	26	2°47	0°38	45°35	
27-8	26	1°20	1°46	46°35	
28-8	26	-	2°41	47°34	
29-8	26	1°52 N	4°11	48°54	
30-8	27	4°23	5°25	50°14	
31-8	26	7°38	7°13	52°00	
1-9	26	10°3	8°51	53°41	
2-9	26	11°56	10°14	55°8	
3-9	26½	14°7	11°55	57°4	
4-9	27	15°56	13°23	58°34	
5-9	26½	17°9	15°2	60°8	
6-9	27	18°13	16°30	61°37	
7-9	27	18°41	17°36	62°56	
8-9	27½	19°10	18°49	64°15	
9-9	27½	19°35	20°9	65°40	
10-9	27½	19°36	21°49	67°26	
11-9	28	19°44	23°36	69°16	
12-9	29½	19°53	24°43	70°27	
13-9	29	19°55	25°22	71°8	
14-9	28°6	-	-	71°36	
15-9	28	20°26	-	-	
16-9	29	-	-	-	anchoring at Surate
17-9	29	-	-	-	idem
18-9	29	-	-	-	idem
				-	stay in Surate
2-3-1751	26¼	-	-	-	

3-3	27½	19°40	from St.John 0°36 W	-	
4-3	27½	19°11	1°20	71°57	
5-3	28	18°35	2°11	71°3	
6-3	31	17°5	1°48	71°27	
7-3	31½	15°54	1°16	72°00	
8-3	31	15°8	0°31	72°45	
9-3	30	14°20	0°26 E	73°46	
10-3	31	13°42	1°28	74°44	
11-3	30	13°26	1°43	75°12	
12-3	30½	-	-	-	in sight of Bassalore
13-3	30½	-	-	-	at anchor at Mangelore
				-	stay in Mangelore
21-4	31½	-	-	-	raising anchor
22-4	31	-	-	-	
23-4	32	10°42 N	from Sacrifice 0°12 W	-	
24-4	31¼	10°1	0°9	-	
25-4	31	9°26	0°6	-	
26-4	32	8°25	0°7 E	-	
27-4	29	7°55	0°16	-	
28-4	28½	7°20	0°37	-	
29-4	28	6°4	0°59	-	
30-4	28	5°14	3°3	-	
1-5	29	4°46	5°27	-	
2-5	28	5°7	7°15	-	
3-5	29	5°34	9°37	-	
4-5	28	6°3	11°54	-	
5-5	27½	5°31	14°6	-	
6-5	28	6°6	15°58	-	
7-5	29	6°4	17°39	-	
8-5	29	6°18	-	-	in sight of Ronda
9-5	29½	6°18	from Ronda 1°52	-	
10-5	31	6°32	-	-	
11-5	30	6°10	-	-	observing Pulo Buton & Pulo Pera

12-5	30¼	-	-	-	observing Kedah
13-5	-	-	-	-	anchoring at Kedah
				-	several stops
3-6	-	3°27	-	-	leaving Salangore
4-6	29	2°58	-	-	
5-6	30	2°42		-	Cape Rachada
6-6	29	-	-	-	
7-6	29	-	-	-	
8-6	29	-	-	-	at Malacca
9-6	29	-	-	-	
10-6	28¾	-	-	-	observing Formosa
11-6	30¼	-	-	-	
12-6	30	-	-	-	at Pulo Pisang
13-6	31	-	-	-	
14-6	31	-	-	-	
15-6	31	-	-	-	
16-6	31	-	-	-	observing St.John
17-6	31	-	-	-	at St. John
18-6	27	-	-	-	out of Street of Malacca
19-6	29	3°54 N	from Pulo Timon 0°39 E	-	
20-6	29	5°2	1°10	-	
21-6	28	7°5	2°00	-	
22-6	28½	8°56	3°28	-	
23-6	29	10°37	4°10	-	
24-6	29	12°40	from Pulo Sapata 2°32	-	
25-6	29½	14°28	3°54	-	
26-6	30	16°20	4°39	-	
27-6	31	17°29	4°23	-	
28-6	31	18°18	4°2	-	
29-6	31	-	-	-	
30-6	31	-	-	-	observing China

1-7-1751	31	-	-	-	passing Macao
				-	stay in Canton
6-1-1752	18	20°52 N	from Ladron 0°13	-	
7-1	21	18°34	1°12	-	
8-1	23	16°1	1°26	-	
9-1	25	13°31	0°26	-	
10-1	25	11°00	1°16 W	-	
11-1	26	8°55	3°37	-	
12-1	28	6°58	from Pulo Condore 0°33	-	
13-1	27½	4°37	1°34	-	
14-1	27	-	-	-	observing Timon, Pisang &, Auroe
15-1	27¼	-	-	-	observing Lingin
16-1	28	-	-	-	observing Mount Monopin
17-1	29	-	-	-	passing Street of Bangka
18-1	28¼	-	-	-	passing Two Brothers
19-1	28½	-	-	-	crossing Sunda Street
20-1	28	-	-	-	in Mew Bay
21-1	28	-	-	-	idem
22-1	28	-	-	-	
23-1	29	8°11	from Head of Java 0°38 W	103°23	
24-1	31	9°00	1°3	103°3	
25-1	29½	9°50	1°27	102°43	
26-1	28	10°25	1°27	102°49	
27-1	27¾	11°53	2°20	101°47	
28-1	28	12°19	2°11	101°58	
29-1	27	12°9	3°14	100°47	
30-1	27½	13°10	5°00	99°10	

31-1	28	13°53	6°44	97°23	
1-2	27½	14°46	8°16	95°48	
2-2	27½	15°40	10°6	93°56	
3-2	27¾	16°8	12°1	92°6	
4-2	28	17°8	14°4	89°59	
5-2	27½	18°17	16°32	87°25	
6-2	27¾	19°26	19°6	84°44	
7-2	27¼	21°34	26°37	81°50	
8-2	27	20°49	24°19	79°24	
9-2	27¼	21°34	26°37	76°46	
10-2	27½	22°21	28°33	74°39	
11-2	27	23°5	30°36	72°20	
12-2	26	23°52	32°54	69°51	
13-2	27	24°31	35°28	67°4	
14-2	27	25°17	38°00	64°15	
15-2	27½	25°48	39°59	62°3	
16-2	28	26°16	41°37	60°14	
17-2	27½	26°46	43°5	58°38	
18-2	28	27°9	44°7	57°27	
19-2	28	27°35	45°4	56°22	
20-2	26	27°41	46°7	55°12	
21-2	28	28°30	48°39	52°18	
22-2	27¾	29°11	50°29	50°14	
23-2	27½	29°43	52°19	48°10	
24-2	26	30°33	53°56	46°19	
25-2	24	31°2	55°35	44°26	
26-2	27½	31°40	56°40	43°13	
27-2	24½	31°54	56°50	42°56	
28-2	25	31°51	57°36	42°7	
29-2	25½	32°9	58°47	40°43	
1-3	27	32°30	59°59	39°19	
2-3	25	33°6	61°50	37°9	
3-3	18	33°22	62°54	35°49	
4-3	22	33°46	64°50	33°27	
5-3	25	34°13	67°2	30°25	
6-3	23	34°51	69°52	27°19	
7-3	22¼	35°34	72°14	24°37	
8-3	22	35°46	72°14	22°53	
9-3	22	35°5	75°49	20°9	
10-3	21¾	34°25	from Cape Good Hope 1°10 W	17°16	
11-3	22¼	33°31	1°54	16°2	
12-3	22	32°47	2°19	15°29	
13-3	22	32°38	3°12	14°26	

14-3	23	31°43	3°37	13°48	
15-3	24¾	30°49	4°24	12°52	
16-3	25	30°33	4°37	12°35	
17-3	24½	30°18	4°55	12°10	
18-3	25	30°13	5°31	11°24	
19-3	24	30°11	5°50	11°3	
20-3	23½	29°34	5°53	11°3	
21-3	24	29°23	6°49	10°1	
22-3	22¾	27°40	8°10	8°24	
23-3	24	25°45	10°15	5°56	
24-3	24½	23°42	12°11	3°58	
25-3	25	21°59	13°47	2°15	
26-3	26	20°46	15°1	1°2	
27-3	26	19°46	15°57	0°3 E	
28-3	26¼	18°8	17°22	1°25 W	
29-3	26¾	16°53	18°22	2°48	
30-3	27	15°29	19°59	4°23	
31-3	27½	13°21	21°28	5°53	
1-4	27	11°23	22°52	7°14	
2-4	28	9°25	24°17	8°34	
3-4	27¾	8°10	25°54	10°6	
4-4	27	7°57	28°30	12°44	
5-4	27	7°49	31°00	15°17	
6-4	28¼	-	-	-	anchoring at Ascension
7-4	28¾	-	-	-	
8-4	28¾	-	-	-	
9-4	29	6°50	from Ascension 1°38 W	16°37	
10-4	29¾	5°50	2°54	17°47	
11-4	30	4°35	4°19	19°7	
12-4	30	3°27	5°33	20°17	
13-4	30°10 [!]	2°30	6°34	21°14	
14-4	30	2°14	6°50	21°38	
15-4	30	1°30	7°30	22°14	
16-4	30¼	0°14 S	8°34	23°18	
17-4	28¾	0°51 N	9°18	24°7	
18-4	29	2°3	9°49	24°34	
19-4	28¼	2°33	9°57	24°49	
20-4	29¼	3°6	10°19	25°16	
21-4	28¼	3°14	10°25	25°19	
22-4	28	3°22	10°25	25°25	
23-4	29	3°40	10°27	25°49	
24-4	27	4°00	10°29	25°51	

25-4	28	5°25	10°36	25°55	
26-4	30	5°35	10°37	25°5	
27-4	29½	5°46	10°38	26°13	
28-4	28¾	6°4	10°54	26°35	
29-4	28¼	6°55	11°52	27°45	
30-4	28¾	7°51	14°18	29°19	
1-5	27½	8°58	15°38	30°40	
2-5	27	9°59	17°1	32°1	
3-5	26½	11°31	18°3	33°4	
4-5	26	12°55	18°47	34°1	
5-5	25	14°20	19°48	35°4	
6-5	25	15°47	20°30	35°50	
7-5	25	17°32	21°8	36°28	
8-5	25	19°17	21°42	37°2	
9-5	25	20°34	22°3	37°24	
10-5	25	21°59	22°26	37°50	
11-5	25	23°21	22°55	38°14	
12-5	25	24°11	23°11	38°29	
13-5	27	24°52	23°6	38°22	
14-5	26¼	25°7	23°6	38°20	
15-5	25	25°49	22°56	38°7	
16-5	27½	26°17	22°50	37°58	
17-5	27½	26°25	22°50	37°58	
18-5	25¾	26°46	22°30	37°48	
19-5	24¾	27°48	22°40	37°57	
20-5	25	28°33	22°45	38°5	
21-5	24¾	29°42	22°32	38°5	
22-5	24¾	30°45	22°40	38°5	
23-5	25½	31°5	22°48	38°13	
24-5	24¾	31°55	22°22	37°45	
25-5	24¾	33°51	20°57	36°6	
26-5	24	35°19	19°40	34°30	
27-5	22¾	36°28	18°40	33°20	
28-5	20½	38°26	17°22	31°39	
29-5	19½	38°41	15°3	28°43	
30-5	22	38°43	13°3	26°10	
31-5	21	39°23	from Fayal 0°18 E	28°45	observing Pico
1-6	16¾	41°7	1°24	27°19	
2-6	17¾	41°53	2°7	26°22	
3-6	16	42°10	3°22	24°33	
4-6	17¾	42°40	3°22	24°28	
5-6	18	42°30	3°49	23°56	
6-6	19	43°39	3°46	24°4	
7-6	20	44°11	4°8	23°57	

8-6	19	45°25	6°4	21°3	
9-6	18¾	46°1	7°24	19°8	
10-6	19	46°27	8°27	17°38	
11-6	19¾	47°32	10°55	14°2	
12-6	[18¼]	48°54	13°21	10°32	
13-6	17½	49°13	14°58	8°11	
14-6	16	49°47	17°12	4°49	
15-6	18	-	-	-	passing the Lizard
16-6	16¾	-	-	-	passing Wight
17-6	17	-	-	-	passing Dover
18-6	18¾	52°37	from Forland 1°13	3°14	
19-6	18½	54°21	1°43	4°2	
20-6	17	54°43	1°7	2°52	
21-6	18¼	55°51	1°56	4°16	
22-6	18¾	56°48	2°31	5°24	
23-6	20½	57°15	3°14	6°51	
24-6	21	57°17	3°52	7°58	
25-6	19	-	-	10°22	observing Jutland
26-6	-	-	-	-	anchoring at Gothenburg

Wcmg2

Bijlagen:

Table 1
<u>Temperature in Cadix (*Freden*, 1748 O.S.)</u>

March 1748	degrees	April 1748	degrees
13	13	1	14
14	13	2	14
15	13	3	15
16	12	4	15
17	12	5	17
18	13	6	16
19	13	7	20
20	13	8	20
21	13		
22	13		
23	12		
24	13		
25	13		
26	13		
27	14		
28	14		
29	14		
30	14		
31	14		

Table 2
Temperature in Canton (*Freden*, 1748-1749 O.S.)

August 1748	degrees	September 1748	degrees	October 1748	degrees
		1	26	1	24
		2	30	2	25
		3	30	3	25
		4	29	4	25
		5	25	5	25
		6	28	6	24
		7	29	7	25
		8	29	8	26
		9	27	9	27
		10	26	10	26
		11	26	11	25
		12	26	12	26
		13	26	13	28
		14	27	14	28
		15	29	15	21
		16	29	16	19
		17	29	17	26
		18	29	18	26
		19	29	19	26
		20	30	20	27
21	28	21	28	21	21
22	26	22	29	22	23
23	27	23	30	23	23
24	28	24	28	24	26
25	30	25	27	25	26
26	29	26	26	26	22
27	30	27	25	27	21
28	27	28	24	28	19
29	28	29	24	29	20
30	26	30	24	30	19
31	27			31	19

November 1748	**degrees**	**December 1748**	**degrees**	**January 1749**	**degrees**
1	23	1	19	1	11
2	24	2	19	2	11
3	25	3	20	3	12
4	25	4	23	4	12
5	22	5	24	5	13
6	21	6	22	6	14
7	21	7	22	7	14
8	22	8	22	8	16
9	21	9	22	9	16
10	17	10	15	10	19
11	13	11	15	11	20
12	12	12	15	12	20
13	12	13	20	13	20
14	14	14	19	14	22
15	14	15	15	15	22
16	17	16	15	16	10
17	23	17	15	17	9
18	25	18	15	18	5
19	26	19	15	19	4
20	25	20	15	20	7
21	24	21	15	21	9
22	23	22	15	22	9
23	14	23	13	23	13
24	13	24	15	24	14
25	11	25	14	25	15
26	11	26	13	26	16
27	12	27	12	27	16
28	12	28	12		
29	18	29	12		
30	18	30	11		
		31	11		

Table 3
Temperature on Johanna (*Götha Leyon*, 1750 O.S.)

August 1750	**degrees**
16	24
17	25
18	26
19	26
20	27

Table 4
Temperature in Surat (*Götha Leyon*, 1750 O.S.)

September 1750	**degrees**
16	29
17	29
18	29

Table 5
Temperature on Ascension (*Götha Leyon*, 1752 O.S.)

April 1752	**degrees**
6	28º15
7	28º45
8	28º45